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AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Project | Date | Author

SUBJECT—

TITLE

TO SAVE THE TREES BEYOND

COLORADO SPRUCE BEETLE

1951 CONTROL PROJECT

Forest Service
U. S. Department of Agriculture, Denver, Colorado - 1951

INDEX NO.—

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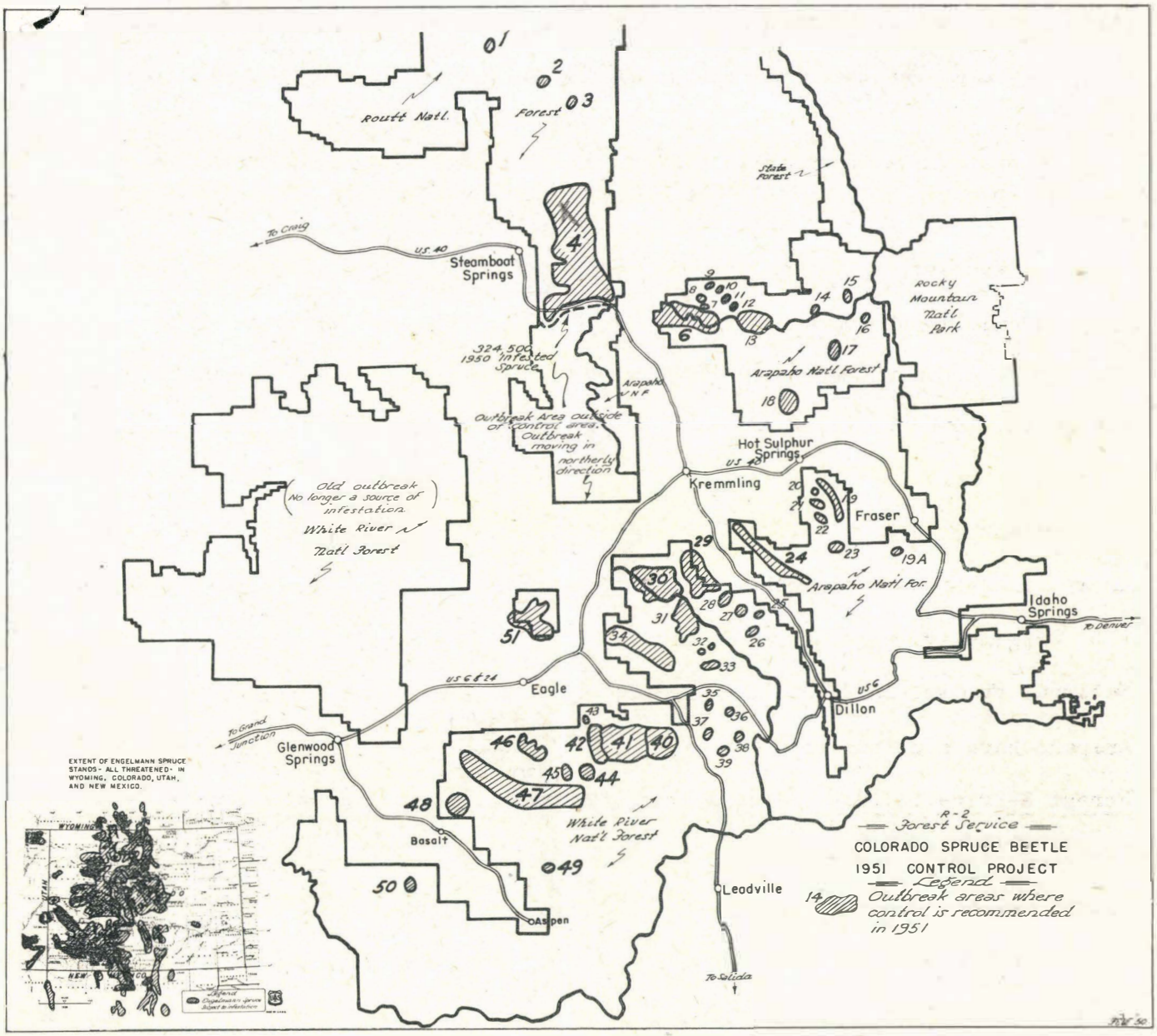
FILE COPY MISSOULA FOREST INSECT LABORATORY

Revised 10/31/51

TO SAVE THE TREES BEYOND



Forest Service

U. S. Department of Agriculture

Denver, Colorado

1951

RED 11/6
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ALG 11-8

BACKGROUND

June 15, 1939, was the day of the big blowdown. Steady-blowing gales that swept up from the southwest across Colorado reached 70 miles an hour on the vast stretches of the Gunnison's Black Mesa, and still had mile-a-minute velocity as they careened over the steep slopes of the Wind River Canyon in Wyoming to the north.

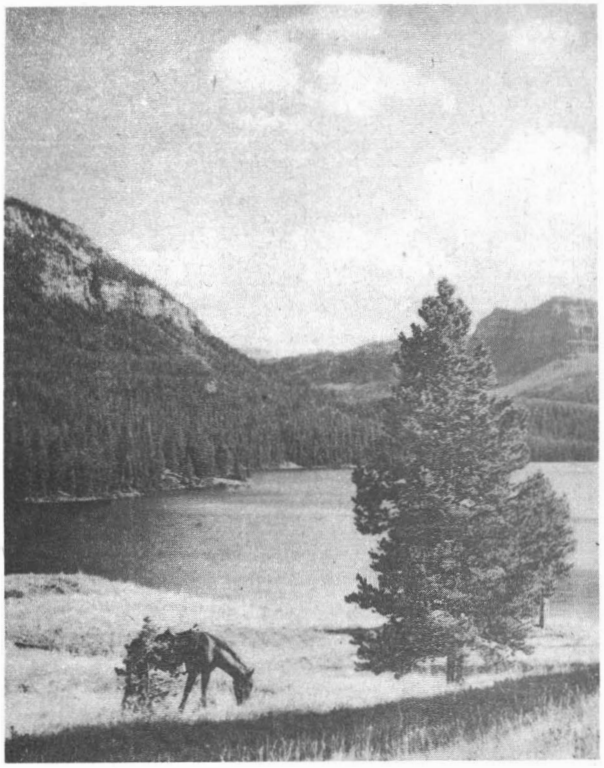
In their wake lay thousands of toppled and twisted aspen, lodgepole pine, and - mostly - the "pancake-bottomed" Engelmann spruce. Their roots half or entirely exposed, these latter were easy prey to the Engelmann spruce bark beetle, long endemic in these western forests. With little or no lifeline into the earth, the spruce could throw out no protective sapstream to repel attackers. Unhindered otherwise, by host parasites or enemy woodpeckers, the beetles bred prolifically - up to as many as 725 in a square foot of bark.

From here dates the beginning of this forest insect epidemic, the worst known in entomological annals, now in its twelfth year of continuing destruction.

Originally, most of the damage was done on the Grand Mesa and White River National Forests in Colorado, although the Gunnison, Routt, Uncompahgre, and Arapaho have also suffered heavy losses. To 9/1/51, the best estimates by the Forest Service indicate a beetle kill of 4.30 billion board feet of timber (about 11.1 per cent of this lodgepole pine, to which the beetle turned as it eliminated the preferred host). CLOSE TO A QUARTER OF COLORADO'S STANDING TIMBER RESOURCES - three-fifths of which is in Engelmann spruce - DEAD ON THE STUMP!

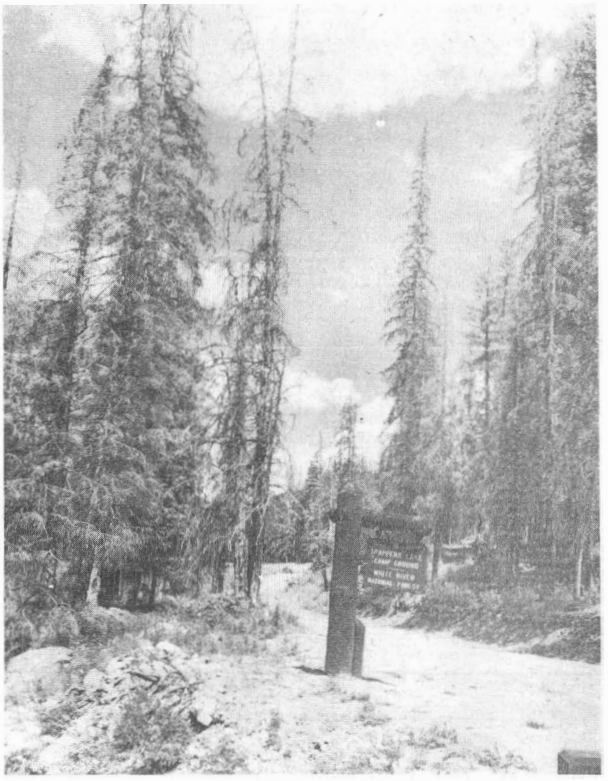
Immediately threatened are 2.0 billion board feet of green Engelman spruce and almost 2 billion of lodgepole pine; potentially threatened is another 10.7 billion board feet of spruce, and almost a billion of lodgepole pine, in Colorado, Wyoming, and northern New Mexico.

Millions of board feet of insect-attacked timber, Parkview Mountain area, Arapaho National Forest



Trappers Lake, White River National Forest - 1940

Two-man crew spraying "goop" on infested Engelmann spruce near Cottonwood Camp, Arapaho National Forest



Trappers Lake Camp Ground, White River National Forest - 1950

INSECTICIDE

= 100,000 gallons

1950

1951

= 100 miles

ROAD CONSTRUCTION

Main haul & treating

1950

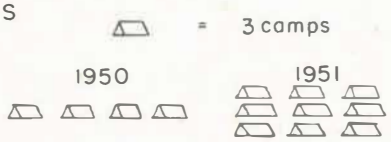
1951

CAMPS

= 3 camps

1950

1951



ACRES TREATED

= 10,000 acres

1950

1951

TREES TREATED

= 100,000 trees

1950

1951

EQUIPMENT

= 100 Automotive Vehicles

= 40 Horses

1950

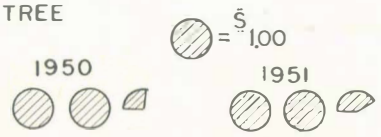
1951

COST PER TREE

= $1.00

1950

1951



MANPOWER

= 200 men

1950

1951

CAMP INSTALLATION COSTS

= $1000.00

1950

1951

STANDBY FOR A DECADE

Concern was immediate over the situation. Too little was known, however, about the habits of the destroyer beetle to develop control methods. The Bureau of Entomology and Plant Quarantine -- cooperators with the Forest Service in this whole project since the beginning -- was called in and began an intensive study of the insect's life cycle.

Before completion of the study came World War II. By then, almost unsuspected, the epidemic stage had been reached: the beetle blitz was on. But because of the shortage of manpower and materials, any concerted effort at control was not considered feasible.

Study of the beetle's habits and survey of its incursions into the Engelmann spruce and, later, lodgepole pine, continued, however. By a decade after the blowdown, several facts had become apparent:

1. The beetle had so well established itself that, unless stopped by radical control methods, it was well on the way to going through all the rest of the contiguous spruce stands.

2. Natural enemies -- parasites, and especially woodpeckers -- were increasing and becoming effective.

3. Unusual winds had spread the beetle into new areas on the south side of the Colorado river and eastward around the fringes of Middle Park.

4. These winds, while generally ill, blew specifically good: for, on the flight across valleys and lower mountain slopes where there was no suitable host timber, large numbers of beetles were lost; and, too, the flight had been dispersed over rather wide areas resulting in a relatively low epidemic population.

These factors made one point clear: control should come now -- or never!

"OPERATION B" - FOR BEETLE - 1950

The 2-year life cycle of the beetle made this evident: areas newly attacked in 1949 could be expected to contain the attack within their boundaries with little extension in '50 and '51 — IF a large-scale control project were launched on the entire eastern and southeastern salients in 1950.

Final surveys to determine exact locations and extent of infestations were begun in late summer of '49; and, that fall, a pilot control project operated on Basalt Mountain, White River National Forest. Cost estimates for the 1950 phase of the control project went to the Bureau of the Budget and the Congress during the winter.

Operational planning continued during the spring of 1950. In late June, the Congress appropriated $2 million to the project. By that time, the control organization — already poised — opened its attack.

Material and equipment came from surplus lists or on loan from such agencies as the Department of Defense. Camps mushroomed as fast as roads could be fingered into their proposed sites in the infested areas. By July 25, ten camps were up and in operation; a month later, three more were in; and, at the peak, as many as 900 men were spread out on 75 miles of front lines in a 35,000-acre area.

Road building was a must on the project; and speed in construction, of the essence. Much of the infestation lay in inaccessible portions of the high Colorado Rockies where there were few or no roads.

Five months after the first location stake was driven, on April 19, 334 miles of new mail haul and treating roads had been built, 54 more miles of existing roads improved — an average of better than two miles a day in rough country.

Road construction crews barely kept ahead of treating crews. They had to keep ahead, however, so that camps could be established and infested areas made accessible in time to complete the planned program before snow would drive control crews from the woods. Success or failure of the project could be chalked up at this point.

OBJECTIVES ACCOMPLISHED

1950

Not to save the trees already attacked -- they were dead, and of salvagable value only -- but to save the living trees beyond: that was the ultimate purpose of the Insect Control Project. Its immediate objective in 1950 was to treat all 1949 attacked trees in areas worked up to a total of at least 500,000 trees. That goal was exceeded by 57 percent: a total of 785,000 trees were actually treated. Of these, about 620,000 were 1949 attacked trees; the rest, 1950 attacked.

All '49 trees were treated in all areas where work was done except two: there, number of attacked trees was so large, and control work begun so late that treat-the-most-possible to lower beetle populations -- and thus lessen danger of spread to other areas -- was the order of the day.

Over one million gallons of insecticide were used on the job -- an average of about 1¼ gallons per tree. Over 52,000 man-days were spent on treating operations, and these man-days produced an average of 15 trees per man-day found, marked, and treated.

1951

The survey of 1950 indicated that in 1951 over 1,600,000 trees should be treated to stop the epidemic. Happily, nature upset these findings. Weather conditions produced a deep freeze that in places eliminated many of the 1950 beetle broods above the snow line. However, the winter mortality was not adequate to stop the outbreak. It was, nevertheless, a factor that made a reduced program from that originally planned entomologically sound. The cost to treat the trees attacked, as found in the survey, was estimated at $3,895,000. However, as time passed without funds being made available, a full program for 1951 was impossible. The helpful effects of winter mortality, woodpecker work, and the control work of 1950, in reducing the number of trees that should be treated, also became more apparent as time passed. The need for additional help by man to reduce the beetle population was still urgent to protect the trees beyond. Therefore, when a million dollars was finally appropriated by Congress late in August, there was still time to do some good and take advantage of the existing favorable circumstances. Overcoming many obstacles in a suprisingly short time, control work was under way by August 28 with snows and cold weather closing down the project by October 20.

Labor supply was a major problem. The late start and short season kept many laborers away that might otherwise have been available. This was in part overcome by the employment of Navajo and Zuni Indians. They formed the backbone of the labor force. The short 1951 program treated 199,002 trees and 2622 trap trees were felled (1409 of these trap trees felled by cooperating loggers); 53 miles of roads were built and a total of 17,135 man-days were used on the project. (Note these figures subject to change.)

1952 - TO SAVE WHAT WAS DONE IN '50 AND '51

From the beginning, both Forest Service and Bureau of Entomology and Plant Quarantine conceived the control campaign as extending over several years.

Some control of beetles attacked in 1951 was done this year. Many '51 attacked trees were not reached in the short control period and still harbor healthy beetle larvae. These, if uncontrolled in 1952, will emerge in '53 to continue spreading the infestation to timber threatened prior to initiating the control project.

The '50 control project made vast reductions in the numbers of the beetle brood which would have attacked in '51. The brief campaign carried out by the Forest Service this year resulted in a definite reduction of the beetle brood that could attack in 1952.

After considering the survey findings for 1951, it appears that about 400,000 trees should be treated in next year's campaign. This includes 225,000 trees attacked in 1951 and an estimated 175,000 trees to be treated as a result of the 1950 and expected 1952 attacks.

As with any fight, it should not be started unless it can be fought through to victory. Having begun this campaign in 1950 with an investment of $2 million, and another million dollars in 1951, it is essential to carry it through 1952 and undoubtedly some work in 1953 with a minor amount of work for a couple of years thereafter.

LIFE HISTORY OF THE ENGELMANN SPRUCE BEETLE

Attacking Adults

Soon after snow melts in the spring, mature adults emerge from under the bark of trees where they developed and that they killed. They fly short distances to nearby green trees or farther when no local ones are available, in which to build their egg galleries. Several thousand beetles attack a single tree in a day or two; trees are soon overcome by the mass attack. Females followed by males construct a vertical gallery in the living inner bark about 7 inches long; in it she lays about 140 eggs. The period of attack extends from about June 21-August 1. Each pair of insects builds one gallery per season. During August and September these parent adults come out of their galleries and congregate under the bark at the base of the tree. Those with sufficient vigor emerge again next spring to attack new trees and lay an additional batch of eggs.

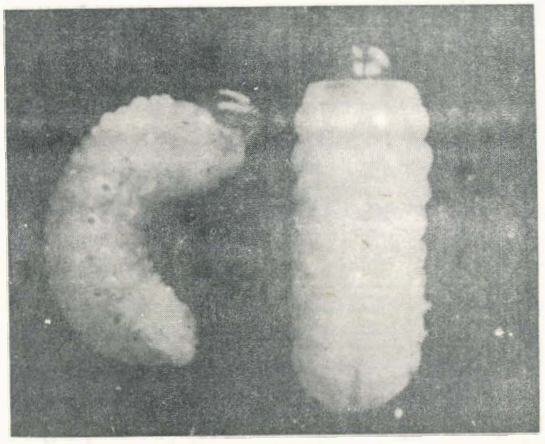
Adult- 10X

Egg Stage

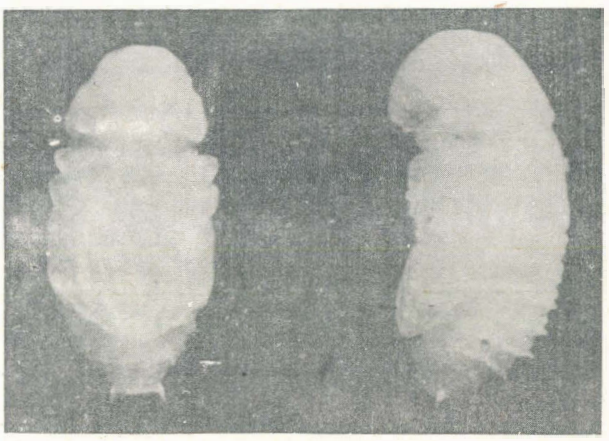
Eggs are laid during July and early August. They hatch in about 14 days, are pearly white and barely visible to the naked eye.

Eggs - 30X

Larval Stage → **Pupal Stage**



Larvae-8X



Pupae - 8X

Larvae feed in a mass on the living inner bark at the side of the egg gallery consuming it as they go. When about 1/3 grown, usually about the last of August and early September, they make separate sinuous feeding galleries throughout the inner bark. By October 1 feeding stops because of cold temperatures. The larvae remain dormant in the inner bark throughout the winter. Feeding is resumed in June of the following spring. The larvae reach the full grown stage in July when each builds a cell in which to pupate.

The pupal stage is a transformation period from the larval to the adult stage. No feeding is done during this stage - largely occurring during late July and early August. The pupal stage lasts about two weeks.

New Adult Stage

Adults, first cream-colored, gradually change to a reddish-black stage over a period of about two weeks. During this time, they feed on the inner bark. In late August and all of September, most of these newly-formed beetles emerge from the bark of the upper stem of the tree to congregate beneath the bark at the base of the tree. The following spring they are mature and ready to attack new trees. The life cycle is completed in two years: i.e., progeny of the beetles from the 1949-infested trees will be mature and ready to attack new trees in June and July of 1951.

1/3 GROWN LARVAE FEEDING IN INNER BARK - 2 X

BARK REMOVED TO SHOW WORK

DIRECT HITS!

Fire hazard and, consequently, fire control costs would be increased in direct proportion to the amount of timber killed by the beetle, since the enormous quantities of dead timber would create a much more hazardous fuel type than normal green spruce forests. A fire would be disastrous, destroying protective cover on thousands of acres of steep, watershed lands.

Affected would be:

1. Water With the area denuded after a fire, a dead forest is always a high liability, surface water runoff and flood hazards would be increased and immediate. Areas downstream would be endangered, with consequent siltation of irrigation ditches, reservoirs, conduits, and other water-using projects.

2. Employment Employment potentials would be seriously reduced. It takes 4 man-days of labor to produce 1,000 board feet of lumber from woods through mill. For the nearly 20 billion board feet of timber involved -- on a basis of 100 working days a season, cutting under sustained yield on a 40-year cutting cycle -- a total of 20,000 men per year could be employed in perpetuity.

3. Business Aesthetic values would be impaired: a forest of dead trees is a dismal advertisement for tourists who, in a normal year, add millions of dollars to the economy of the region.

Employment potentials, as above, with the concomitant economics involved, are an important part of this picture: every "man" of the 20,000 employed earns a normal $12 per day in wages, for example.

Wherever people have settled in the West, availability of adequate supplies of water -- for domestic, irrigation, and industrial purposes -- has been the limiting factor in economic development. As a result of this insect epidemic, watershed protection and water production values are not only directly impaired -- especially on steeper slopes -- by loss of the living tree canopy; but the possibility of even greater indirect loss as the result of a disastrous fire, is tremendous.

4. Recreation For all recreationists, dead trees are a poor substitute for the living forest. The eventual mass of down and criss-crossed trees would make the area tough going for both animals and hunters. Again, possible fires and subsequent erosion and siltation would eventually ruin fishing streams.

VOLUME AND VALUE
TIMBER KILLED AND THREATENED
ESTIMATE AS OF SEPTEMBER 1951

DEAD

Engelmann spruce	3.80 billion board feet
Lodgepole pine	0.50 billion board feet
Total stumpage	4.30 billion board feet

Values lost to date - Value at $4.50 per MBM for 70% = $13,545,000
(average selling price for FY 1951 and 70% of volume operable)

IMMEDIATELY THREATENED

Engelmann spruce	2.00 billion board feet
Lodgepole pine	1.89 billion board feet
Total stumpage	3.89 billion board feet

Value at $4.50 per MBM for 70% = $11,253,000

ADDITIONAL STAND THREATENED

Engelmann spruce	10.64 billion board feet
Lodgepole pine	.98 billion board feet
Total stumpage	11.62 billion board feet

Value at $4.50 per MBM for 70% = $40,670,000

TOTAL VOLUME THREATENED

Engelmann spruce	12.64 billion board feet
Lodgepole pine	2.87 billion board feet
Total volume in path of beetle	15.51 billion board feet

Total value on the stump based on 1951 average selling price of $4.50 per MBM = $65,468,000 for 70% of volume, 30% of the volume is classed as non-operable. Includes dead and threatened.

Economic loss in future wages, processing expenditures made within area threatened, etc., at $50.00 per MBM. A conservative figure at present prices - - - - - - - - - - - - - - $500,857,000

1939 - Blowdown.
1942. White River - few dying trees

1943 - 100s of 1000 of trees
1949 - Increased E.S.B. study.
1949 - Willford, Massey, Terry - Surveys

E.T.B. is ready for use on small area

ETB - 2 year life cycle.

Blowdown good for 2-3 years

200.000 acres over 3.00 [illegible]
2.25

1950 -

400
450
2000
1600
18

T W T F S S M
1 2 3 4 5 6 7

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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Entomology and Plant Quarantine
233 Forestry Bldg., Colo. A & M
Fort Collins, Colorado
November 1, 1951

SURVEY RESULTS
ENGELMANN SPRUCE BEETLE OUTBREAK IN COLORADO
1951

Block	Name	Acres	Number of 1951 Infested Spruce: Full Attacks	Partial Attacks	Basal Fill-ins
1	U.S. 40 to Luna Lake	36,200	39140 ± 6270	9780 ± 2190	42360 ± 7630
2	Chimney Rock	1,330	280 ± 80	440 ± 210	2500 ± 480
3	Elk Mtn.	2,344	1960 ± 350	1030 ± 260	4640 ± 980
4	Williams Ridge	2,990	2000 ± 450	1490 ± 270	4180 ± 1100
5	Surprise Lake	1,280	850 ± 270	630 ± 120	920 ± 390
6	Elliot Creek	4,218	1690 ± 1010	840 ± 227	2100 ± 590
7	Cottonwood Peak	7,574	8630 ± 1970	5300 ± 1244	14400 ± 3940
8	Meadow Creek	973	1670 ± 505	640 ± 155	550 ± 230
9	Red & White Mountain	3,557	5650 ± 920	4840 ± 960	6080 ± 1100
10	Stone Creek	870	520 ± 220	350 ± 140	260 ± 150
11	Beaver Lake	795	4680 ± 1110	1330 ± 470	950 ± 300
12	West L.—East L.	300	1060 ± 360	625 ± 230	690 ± 110
13	Squaw Creek	524	315 ± 130	315 ± 140	545 ± 60
14	Triangle Park	237	200 ± 30	0 ± 0	0 ± 0
15	East Brush Creek	315	1510 ± 720	280 ± 130	280 ± 170
16	Mount Eve	20	300 ± 80	80 ± 25	110 ± 45
17	Hardscrabble Mountain	718	3550 ± 2370	140 ± 100	720 ± 620
18	Red Table Mountain	16,370	57130 ± 8330	15400 ± 2230	55490 ± 6380
	Total	80,615	131135	43510	136774
				Grand Total	311420

Total 1951 full attacks	131,135	
Total 1951 partial attacks	43,510	
	174,645	
Total rounded to		175,000
Approximately one-third of the 136,774 fill-ins will need to be treated in 1952. The light broods in the remaining two-thirds of these trees will be further reduced by natural factors and will not need treatment.		50,000
Total 1951 trees to treat in 1952		225,000

Requested 1.800.000
$450 Per Tree

RCG 11/6
T.T. 11/6 some report!
REO 11/6
GT 11-6
ALG 11-8

Estimated Number of Trees That Will Be Attacked in 1952

The estimate of the number of trees that will be attacked in 1952 must be based upon an appraisal of the beetle populations in the 1950-attacked trees since these trees are the source of the 1952 attacks. The surveys made in the spring of 1951 show there was approximately 87 percent mortality of the population from abnormally low winter temperatures and woodpecker feeding. It is estimated, therefore, that sufficient beetle populations exist in the 1,340,000 untreated 1950-trees to attack approximately 175,000 trees in 1952.

A summary of the estimated number of trees to be treated in 1952 is as follows:

Number of 1951-attacked trees	225,000
Number of 1952-attacked trees	175,000
Total	400,000

Submitted by,

W F McCambridge

W. F. McCambridge
Entomologist